

## Task Force 3: MANAGEMENT OF CAPTIVE BREEDING FACILITIES

Two primary analyses set to this task force: 3.1 & 3.3 Only the Analysis for 3.1 was taken up during the Working Group Meeting.

*Analysis 3.1:* Determine the target captive population size for each subspecies, building on population viability analyses for wild population and demographic and genetic data on which these models are based.

### **Review of the Islands**

This analysis began with an island-by-island review of present population information.

**Santa Catalina Island:** There are 250 individuals in wild and 32 individuals in captivity (including 10 pups). The capacity of the breeding facility is 24 adults and 36 pups for a total of 60 foxes. The current number of wild born pups this year is unknown at this time, however based on estimation of production from previous years the total population has probably risen to be over 300 island-wide. The estimated historical population size was about 1300 foxes. Previous PVA modeling suggested that there should be 150 on each end of the island, for a total island population size of 300 to be self sustaining and maintain population growth.

**Santa Cruz Island:** There are approximately 80 individuals in the wild and 39 individuals in captivity (including 19 pups). The current survivorship of wild foxes is 80%, but is significantly lower for newly released foxes. The capacity of the present captive breeding facility is 30 animals across 15 pens, but there is a plan to build more pens. The historic island-wide population estimate is 1500 foxes.

**Santa Rosa Island:** There are now 8 in the wild, 6 released this year and 2 born from a released pair, and 56 individuals in captivity (including 9 pups). The capacity of the breeding facility is 20 pairs, or 40 animals. The historic island-wide population estimate is 1400 foxes.

**San Miguel Island:** There are no foxes in the wild, and 50 individuals in captivity (including 12 pups). There are 20 breeding pens and 2 quarantine pens, setting the capacity of the breeding facility at 20 pairs, or 40 individuals. The historic island-wide population estimate is 450 foxes.

## Issues Raised in the Initial Stages of Discussion

### Future goals for captive breeding:

What are the purposes of the captive populations?

1. Is it for long-term protection against potential threat and preservation of the species? Or
2. Is it for a temporary sanctuary from immediate threats (canine distemper and golden eagles) for quick return to the wild? Or
3. Is it the production of enough foxes for restoration and augmentation of a wild fox population on each island?

These goals are significantly different and entail different breeding strategies with different population growth trajectories. A short-term decision could have long-term consequences. The current overriding genetic concern is to equalize the breeding representation of the foxes brought into captivity on each island. This genetic driver could change depending on the future goals of the population. These issues need to be analyzed and a detailed description of the difference between the two should be drafted.

The present captive breeding facilities on each island, built to house 30-40 foxes, are designed to produce 12-20 pups per year, the estimated number required to restore or augment the population on each island within a reasonable timeframe (approximately a decade). This is based on an analysis done by Gary Roemer and Phil Miller and presented in a 2001 report for the National Park Service, and was incorporated by the NPS into their 2003 island fox recovery strategy.. In most captive breeding programs, there are a very limited number of founders and the goal is to grow the captive population to a certain secure size before beginning releases. In the current situation we are constrained on the islands by captive population size, because of the number of available pens and costs of maintaining and operating captive facilities on the islands. There are two alternatives: release, or increase the size of the captive facilities. One option for increasing the size of the facilities is to create a mainland breeding facility. However, as mainland captive breeding space becomes available, we need to address the issue of quarantine required to avoid disease transmission risks in bringing foxes to and from the islands. This quarantine time is somewhat lengthy and could still result in some deaths. Therefore in this instance, we aren't in a position to work toward a captive population of hundreds of individuals before we can release them. However, it was still suggested that given the population size on all these islands, especially when the island fox becomes nearly recovered each island fox subspecies should eventually have a reservoir population on the mainland. This line of thinking is confirmed when comparisons are made to other endangered population programs.

It isn't the long-term role of the NPS to support captive breeding on the islands it manages; once the delisting goals are met they will dismantle the breeding facilities. These are different goals than a zoo or a typical captive breeding facility would have. Since it is somewhat established by the task force that it should still be a goal to maintain a captive population in the long term, are there resources that could support this long-

term captive goal? It would most likely have to be a mainland operation, although increases to the present facilities are needed (by building more pens) to meet short-term goals and should not be dismissed.

### Alternatives to Release

It was suggested that we examine a combination approach to be taken for releasing foxes, where not all foxes are released but some are used for a maintenance of a long-term captive population. This maybe an approach that can not be immediately implemented, but perhaps planning and preparing for this in future years is the best option at present. There are risks associated with both actions which should be considered when preparing for these actions in the future. One is moving animals to the mainland, where the primary risk is disease transmission, and the second is for released foxes, which is obviously the risk of golden eagle predation. The predation risk from eagles is changing, and will hopefully be diminished in the future. If we release this year, we would have more time to develop a long-term captive population plan (most likely in the zoo community). Also, there may be significantly different strategies for the different islands, which need to be considered and determined before steps are actually taken to establish a long term mainland captive population. Another issue that will need to be resolved is what is the minimum number that should be released to the wild or established in the wild before individuals are moved to a mainland captive breeding? Will this number change with changes in population size on each island?

### Mainland Alternatives

We examined whether bringing animals to zoos was a realistic option for this fall. The only facility with space to take more than a few individuals is the Wild Canid Center near St. Louis, Missouri. The facility could provide personnel with canid husbandry experience, but the enclosures needed are not built at present. With funding to build pens they could take animals this fall. If a mainland facility were established, we should identify which subspecies is the most important or most ideal at this point to go to the mainland. Some things to consider with this decision are where is the greatest long-term predation risk, how large is the population, and are there individuals available to move?

The question was raised as to whether quarantine procedures could be developed and ready for implementation be ready by this fall. Foxes to be moved to the mainland would require both island and mainland quarantine. Foxes would also need to be treated for parasites on the islands before they leave, resulting in increased costs. For this treatment, 12 negative fecal sample analyses need to be obtained before an animal can be moved to reduce the threat of spreading spirocerca to the receiving facility. Concerns were raised about a predicted death rate of up to 25% of the animals during spirocerca treatment. There was serious question as to whether the program is prepared to address those risks this autumn.

Therefore, there was agreement in the group that we can not do both (release and establish mainland population) for each subpopulation, at least at this time with the populations sizes still so small.

## **Analysis of Strategies for Each Island**

For each island we evaluated three options: 1.) Do we release individuals to the wild and if so how many? 2.) Do we keep individuals in captivity and if so how many? Will this require an increase in the size of the current facilities? 3.) Do we move individuals to a mainland captive facility? The last option was discussed previously and determined to not be the best option this year, but was something to be reconsidered for next year.

Catalina Island: The PVA model which determined the target number of individual for the wild required a minimum of 150 foxes on each end of the island for a total island population of at least 300. It was suggested that the model be independently reviewed by PVA experts chosen by the population modeling expertise group. With the confirmation of the results of the program, we would then proceed with the following suggestions.

The proposed plan was to release this year's pups, as they have done in the past, based on the idea that they may have reached this target number proposed by the PVA model. One question managers wanted to know was if it would be an acceptable time to also release the adults and close the captive breeding facility. The main reason for this suggestion was that costs of the program are high and the funding for the program next year is not yet secured. In addition, available funding would need to be split between maintaining the captive population and conducting monitoring of the wild population, which would make money thin. Additional support for this action is provided by the very high productivity and survivorship among the wild foxes on Catalina. In addition, the purpose of the captive facility was to function as a source population and reserve against distemper impacts. The distemper threat is now minimized, and recovery efforts could be shifted from the captive population to release and monitoring of the wild population. One concern raised was that it might be premature to shut down the captive breeding without any delisting criteria established.

Genetic studies on the Catalina Island fox have not been recently performed and nothing is known about how the virus has affected or changed the overall genetic makeup of the population. It would also be important to compare the genetic diversity before and after the outbreak to see if the genetic diversity has been reestablished. This could also assist in the development of delisting criteria. Genetic analysis of the Catalina Island could be used to implement noninvasive monitoring of the wild population for future years, which could be important to ensure that the population fully recovers from the outbreak.

The different alternatives discussed for the captive population were: 1) to release all the pups; 2) to release some pups and adults; 3) or to release all captive Catalina foxes. Some of the questions raised about each of these options were: if peer review of the PVA model shows that a population of 300 is adequate is the total release of the captive population the best option? What would be the costs be to bring all the animals back in to

captivity if when they were released monitoring showed the population was crashing again? If we release half of the captive population, we could keep some in captivity until the island population is confirmed to be over 300 and the PVA model has been peer reviewed. However, we would learn more by including some adults and/or family groups in the release. Is there a difference in the threat to wild vs. captive animals? No. The threat is at an equal level with either alternative. So if the threat is the same between the two situations, why couldn't we let them all go? Are costs the same? While it is may be more expensive to monitor the population if it is released than if it is captive, and it is definitely more expensive to do only a partial release and keep some in captivity. What about animals that can't be released? They could have some role in the zoos or the Catalina Conservancy education program as exhibit animals. On the contrary, the zoos do not want to be a dump for unreleasable individuals. This is something that can be dealt with when the decision is made though. Also, does it make sense to release all individuals if some may have to be brought in for supplemental feeding or injury? One option was to keep the individuals that are not releasable in captivity, and any others that may have to be brought in, and use those individuals for the mainland Catalina subpopulation at a zoo.

Partial release of pups and adults (up to half the animals currently in the captive breeding facility) was the favored option by a strong majority. However, because partial release is the most expensive option, we polled again for a second choice if our first option could not be met do to lack of funding. The second choice was between releasing just the pups and or releasing all foxes from captivity. Estimates of this years numbers suggested that with this springs' reproduction, there probably are over 300 animals in the wild. If there is not adequate funding to maintain the captive facility and do monitoring of the foxes to be released this year, there was consensus favoring full release, maintaining the facility as a contingency if recapture was necessary.

San Miguel: There are currently no eagles observed or known to be nesting on the island. There are 50 foxes currently in captivity, and the number of founders is 7, out of a potential 14. Some of the questions posed for individuals on San Miguel were: should we release older unsuccessful breeders that are potential founders? A move to a mainland captive facility may delay breeding, which would exclude older females. Can we move to mainland this fall or does the spirocerca treatment quarantine preclude that? Should we test treatments on a subpopulation of animals? It was noted that we really have no genetic redundancy in a population of 50.

The overall consensus of the group was to release up to 10 animals to start the reintroduction process, which represents 20% of captive population. The soft release protocol would be used with these individuals as is done on Catalina. This strategy has significant risks and it was suggested that some mitigating measures such as predator avoidance could be considered in conjunction with such a release.

The optimum genetic management would require a captive population double the current size. In this case we are instead working with a small-scale model; if we want to go

large-scale we would need 80-100 animals in captivity which is logistically unrealistic on the island.

Santa Rosa: It was proposed that we release up to 15 animals using soft release protocol developed on Santa Catalina. One issue that came up in regards to releases on Santa Rosa was that carcass availability during deer and elk hunts on the island could be a major factor in drawing eagles to the island from Cruz or the mainland, and thus reducing the release success of the foxes and altering the ability of NPS personnel to monitor fox activities. Therefore, a plan to deal with both deer and elk carcasses has to be part of the plan for release of foxes.

Socialization before release could affect success, so it was recommended that pens for putting pups together before they are released should be used. These exist on Santa Rosa and this procedure has been done in the past, but they are currently full, so more pens are again needed. Also, releasing pairs that have been together but haven't yet bred should be considered, in light of last year's release. An anti-predator evaluation into pre-release protocol should be considered, keeping in mind that there are costs as well as benefits in selecting for these behaviors.

Santa Cruz: Survival of wild foxes is high, but this may be a different situation in light of ongoing eagle predation, particularly of released foxes. With this in mind some further questions were raised. Is this the best place for predator avoidance training? Is this the best population to consider for the mainland move? This population is the largest and has a considerable wild population, so there would be animals available. However, because there still is a wild population, there may not be the greatest need for preservation of this captive subpopulation on Santa Cruz. On the other hand, if the long-term goal is to protect the population from future catastrophes, it may be wise to have a redundant captive population. However, because of predation this population only reproduces itself over the period of three years. In order to work on the predator recognition we might want to put animals out and study their behaviors. There is ongoing research that might answer some of the questions regarding behavior and predation risks.

If we are selecting animals for release based on certain traits, i.e. if we want animals that are not out during the day because they are at less risk for predation, we may be selecting the unnatural traits, because foxes are naturally diurnal. It was stated in contrast to that view that this is a very short time for selection to take place and maybe okay and worth the risk to preserve the species and have a larger breeding population. If we do not select for behaviors, but have information regarding their personality before they leave, we can then relate survival to those previously measured traits/personalities, and we can work on releasing those individuals most likely to survive until the threat of predation is nearly gone.

In deciding if we should release on Santa Cruz this year there were several significant considerations. The first is pig removal, which will be managed in five zones. The contractor will be paid when each zone is proven to be pig-free, and may be working on more than one at a time, so conceivably there will soon be pig-free zones. Dogs used in

the hunt will be trained to take only pigs; if they take anything else they will be removed from the island. The health group last year developed quarantine procedures for dogs coming onto the island for the hunt. The dogs probably only come out to the island one time as the dogs would have to go through quarantine each time they returned to the island. It must also be recognized that there is a risk of the dogs picking up the spirocerca from foxes.

There are risks to foxes on this island both from current eagle presence and unknowns from the pig hunt. How will the presence of pig carcasses affect fox risk? Next year the availability of a mainland captive facility will be better understood, but that does not address the present situation. We should be getting the protocols in place for moving large numbers of animals to the mainland, in the event that there is a shift in predation by the golden eagles from pigs to foxes. The working model that was developed several years ago said that we would remove the eagles and then slowly release foxes. For the foreseeable future there will be a continuing eagle presence and we will be releasing foxes with some threat of eagle predation.

One proposal was that we do a limited release of 10 foxes. We do not know how many captive pairs are needed on Santa Cruz. It may be less than the number determined for San Miguel and Santa Rosa because there is a substantial existing wild population. Modeling would be useful to determine the minimum number of captive pairs needed, the number of individuals needed to augment the population and a size threshold for self sustaining population growth. More pens will need to be built to house the current population, if we did not release or move individuals to a mainland facility. There should also be extra pens available during the pig removal in the event a crash occurs due to prey switching by eagles or some other factor. If we ever want to utilize the benefits that zoos offer for fox conservation, we need to start the veterinary procedures to determine that it is a feasible option. We should start treating individuals that would be most likely to be moved to the mainland facility. Pups seem like the best option for preliminary treatment as they would have the lowest mortality from parasite resistance treatments and they are most likely candidates for an initial mainland move.

By a two to one margin, the group was opposed to a fox release on Santa Cruz this year. What then do we do with extra animals such as the new pups for which there currently is not any space? They can not go to the mainland this year, so more pens need to be built. There was a consensus that a subset of the captive population should be subjected to parasite treatments that would be needed if they were going to the mainland. This would not only prepare them for a move to the mainland but also allow us to obtain information on the effects of parasite treatment, which should be reduced for young pups that have not been in contact with the parasites as long as adults. The veterinary and genetic management group will be tasked with determining which animals are the best to be included in testing. Also, it was agreed to begin evaluating personalities of the captive individuals for predator avoidance in anticipation of possible future release.

### Triggers for recapture of released foxes

There was a discussion that triggers need to be established for bringing animals back into captivity because of risks of increased predation, and that they might be different for San Miguel and Santa Rosa. There was a great difference in opinion on the amount of predation experts would tolerate before bringing the remaining released foxes back into captivity. Despite the differences in opinion we did come to a majority vote (12-9) to have monitoring increase in intensity if 10% of the released animals die from eagle predation on San Miguel, and if mortality reached 30% all remaining individuals would be trapped and returned to captivity..

The question was posed as to whether 30% is appropriate for Santa Rosa. One comment was made that maybe 30% is too low here because the island has more diverse habitat, and therefore a predation event in one area might not be indicative of refuge sites available in others. The total release number will be larger and 8 individuals resulting from last year's release are still surviving in the wild. In addition, because there are already wild individuals on Santa Rosa, it might take the released ones longer to establish use areas. There should also be flexibility in response to events based on known locations of eagles. The consensus for Santa Rosa was that at 20% predation increased monitoring would take place and 40% predation would trigger either bringing in the rest of the animals to captivity, or relocating them if there are obvious spatial differences in predation risk.

### **Summary of the Analysis for each Island**

The breeding scenario that offers the best chance for long-term perpetuation of the island foxes is for each island subspecies to have at least one mainland captive breeding colony which maintains most of the genetic variability of the island population and from which individuals could be safely moved to the island. No island fox population is in that position, but the analyses for each island are consistent with that goal.

On Santa Catalina Island, the captive breeding program is approaching its release targets established for the wild population. Those targets were established by a population viability analysis; that PVA should be reviewed before the breeding facility is closed. If the predicted population estimates are robust, then it is reasonable to begin closing down the breeding facility and releasing breeding pairs to the wild or sending them to a mainland zoo. A multi-year release strategy would be optimum, with monitoring of the wild population taking an increasing amount of the personnel effort. It would also allow time to develop a strategy for a mainland zoo population with some founders from the island captive facility. If it is not possible to both maintain the captive breeding facility and monitor the released foxes, then a full release is a reasonable alternative, as long as the buildings are maintained in the event that an emergency recapture effort is required.

On San Miguel Island, there are currently 50 foxes in captivity on the island, none in the wild, and no recent sign of golden eagle presence or nesting activity. Given that we do



not at present have an acceptable treatment and quarantine program for moving foxes to the mainland, as well as the NPS goal of restoring the wild population, soft release of 10 individuals with radio collars, will begin the two population safety net and test current survival conditions on the island. If eagle predation on the island resumes, and 3 foxes of the 10 released foxes are killed, then the remaining foxes should be recaptured until the eagle threat is further reduced.

On Santa Rosa Island, there are currently 8 foxes in the wild, 6 survivors from the release last year and 2 born in the wild from a pair that had not bred in captivity. There are 56 animals in captivity, and released foxes would face a greater predation threat than San Miguel (due to potential eagle breeding territories on the island), and a lesser threat than that on Santa Cruz. Given the same risks of a concentrated captive population and no mainland facility ready to receive foxes (nor protocols for movement to the mainland yet tested), augmenting the small successful wild population on Santa Rosa is the best alternative. Given the diverse terrain and the possibility of moving foxes facing predation threats, evidence that 6 of 15 released were taken by eagles would warrant bringing the remaining foxes back into captivity.

On Santa Cruz Island, with the completion of 5 additional pens and establishing a perimeter fence around both captive breeding sites, the captive population on the island will be at capacity and more secure from aggression from the wild foxes. Foxes beyond this pen capacity should either be released to the wild or sent to the mainland to start to develop a captive colony for the subspecies. Because there is a substantial wild population on the island, and because eagle predation conditions on the island are least predictable with the start of the pig eradication program, Santa Cruz is the best of the northern islands to test veterinary protocols for establishing a refuge population for a subspecies on the mainland. As with the release in the presence of golden eagles predation, subjecting foxes to treatment before a mainland transfer could take place also has substantial risks. Mortality triggers for treatment should be established after consultation with the veterinary experts in the task force.